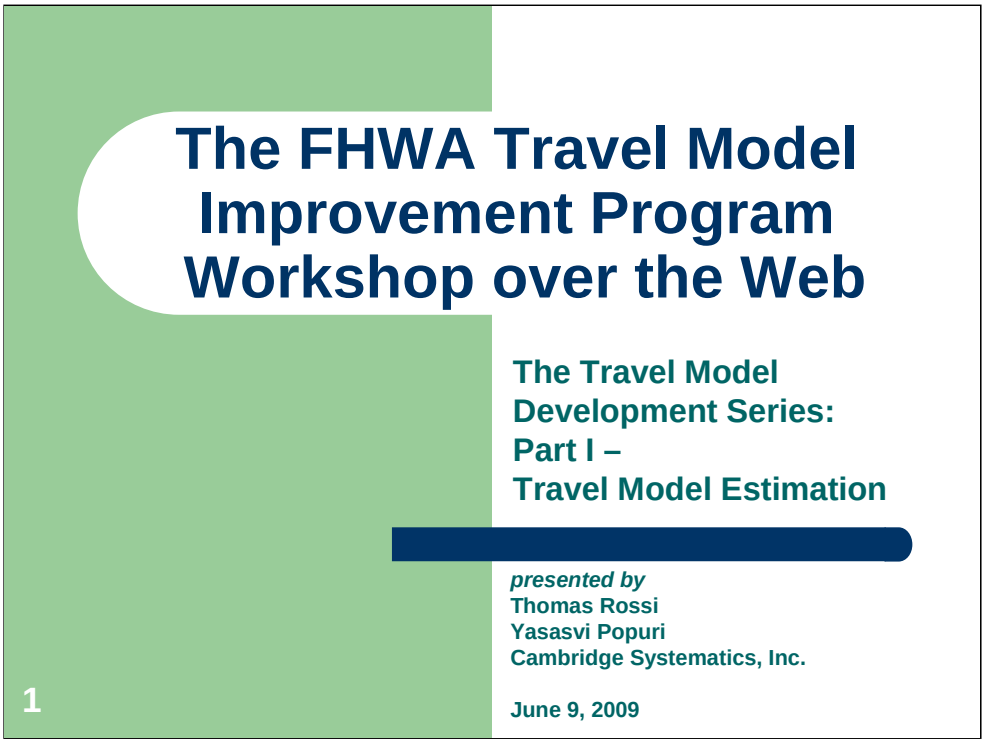
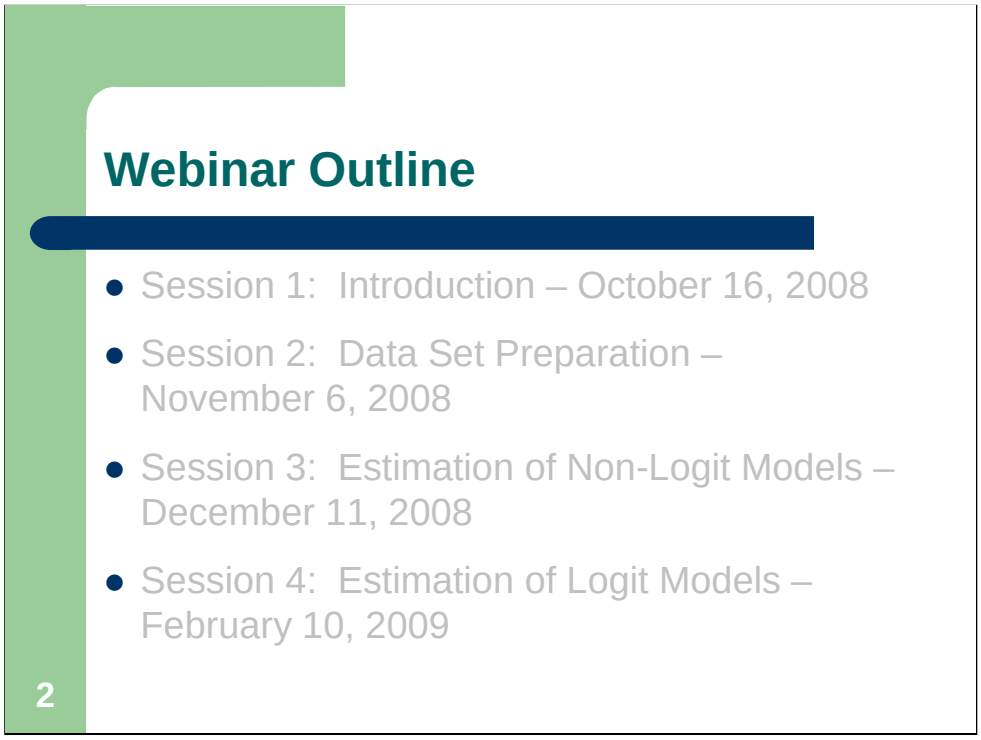


Key Message: Purpose of the Webinar Series

Details:

Welcome to the FHWA TMIP Workshop over the Web. This workshop is targeted at Transportation modelers who have a low to moderate level of familiarity with the estimation and validation of travel models.

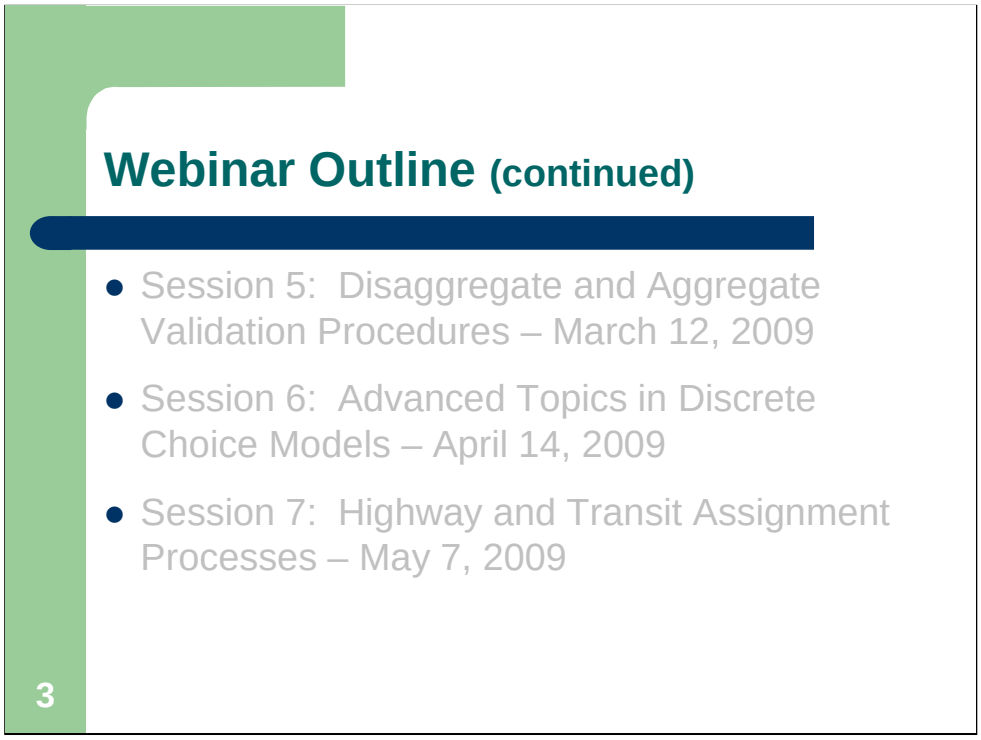
This series of webinars will introduce the development of model estimation data sets, the structures of the various model components, and the procedures for estimating models. The workshop will include lectures, discussion, and "homework," that participants will be expected to complete between sessions.



Key Message: Past Sessions

Details:

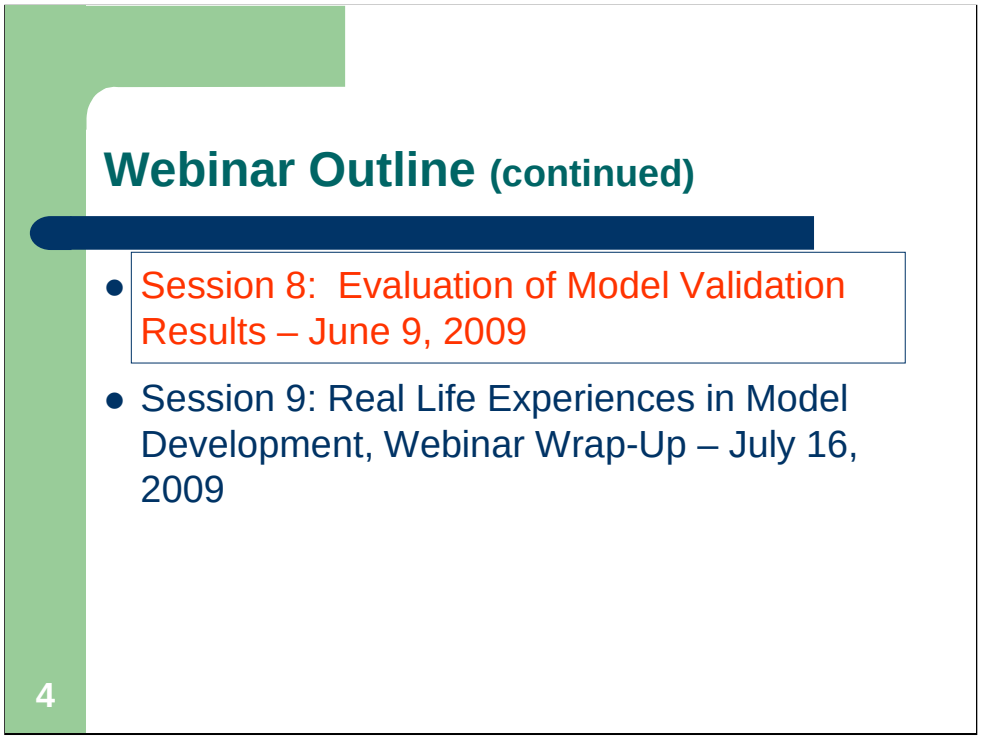
This is the webinar outline. These sessions have already occurred.



Key Message: Upcoming Sessions

Details:

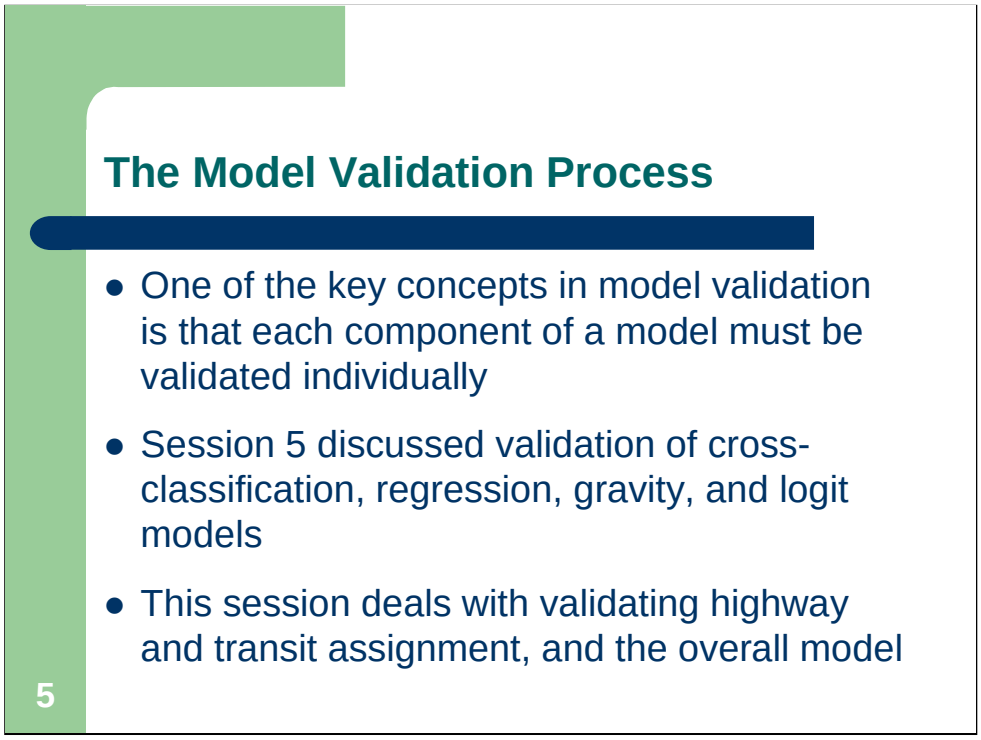
So have these.



Key Message: Upcoming Sessions

Details:

Session 9, the final session, on real life experiences in model development and the webinar wrap-up, will be held on July 16.



Key Message: The Model Validation Process

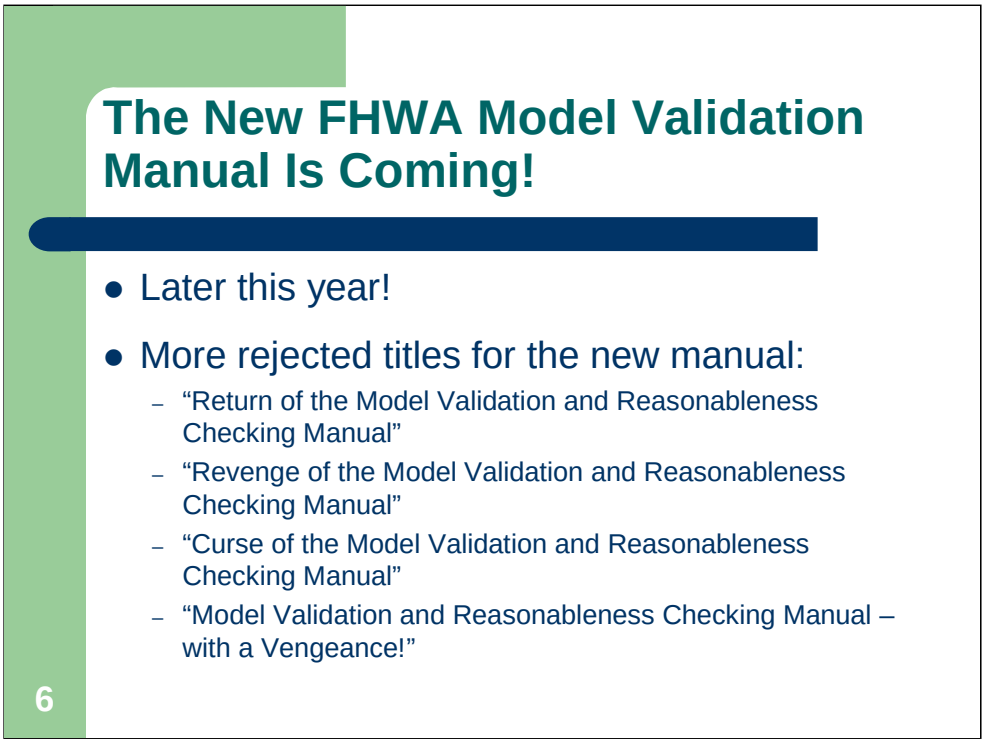
Details:

As mentioned in Session 5, one of the key concepts in the validation process is that each and every component of a model must be validated individually. Session 5 dealt with the validation of model components that were presented in previous sessions in the webinar. These included:

- Trip generation models
- Trip distribution models (e.g. gravity)
- Logit models, including mode choice

This session will deal with validation of highway and transit assignment, which were discussed in Session 7, and of the overall model.

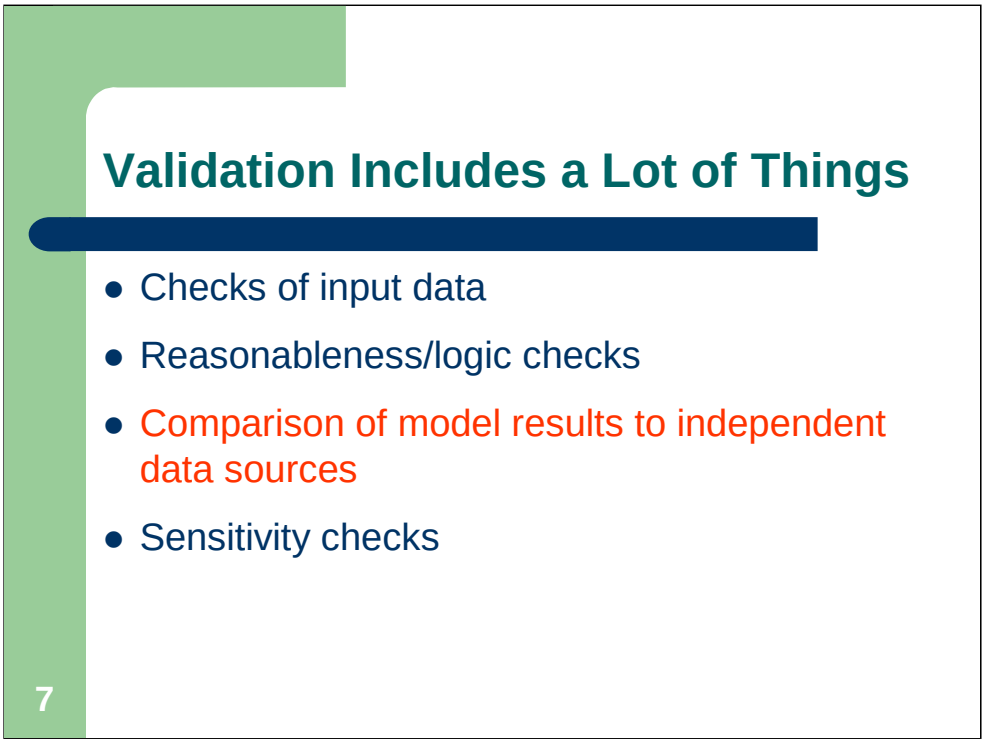
We still hope that this whets your appetite for the complete documentation of model validation that FHWA is currently working on, and that will include case studies and outreach over the web.



Key Message: The New FHWA Model Validation Manual

Details:

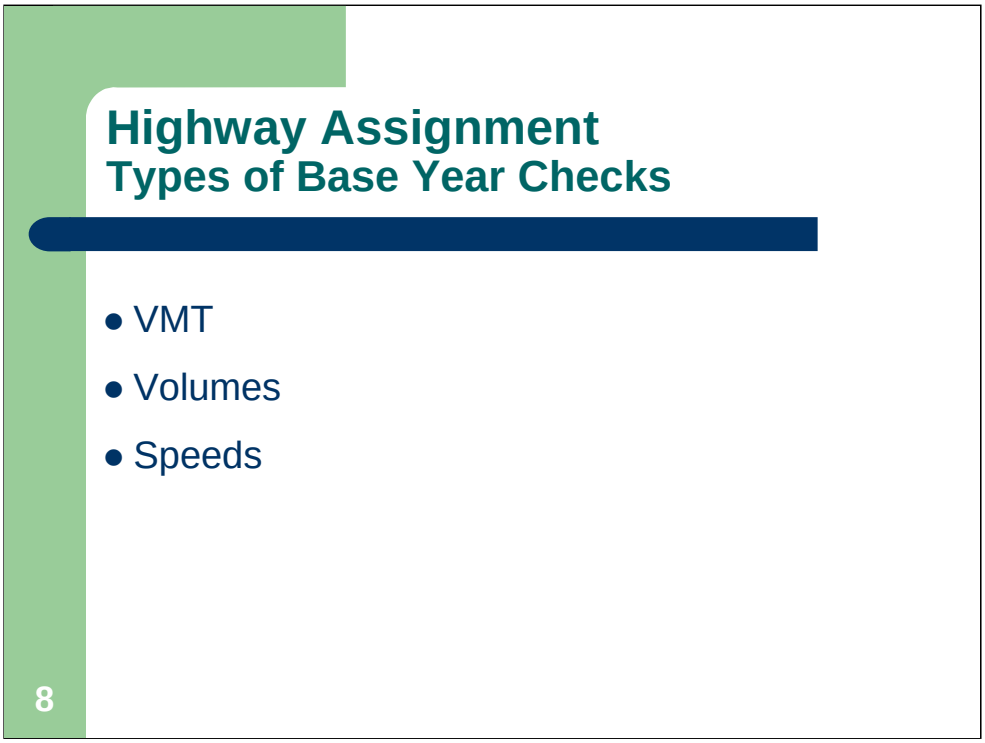
This slide speaks for itself.



Key Message: What is Validation?

Details:

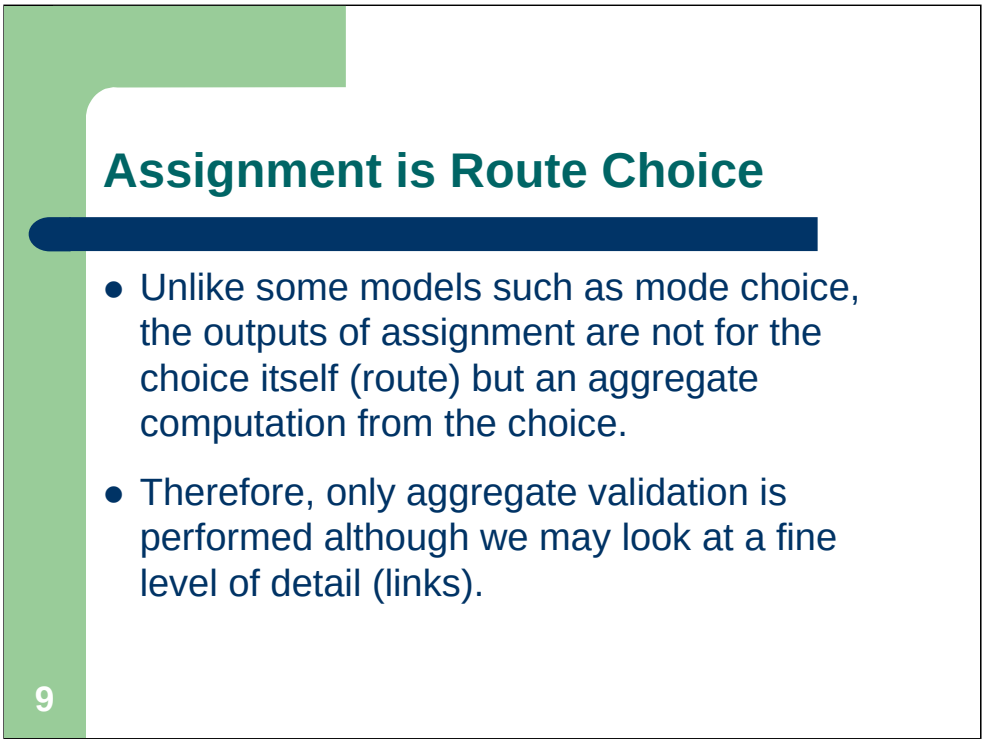
Model validation includes a lot of things. As mentioned in Session 5, a key component of model validation is comparing results to independent data. For highway assignment, this generally means traffic counts, but it can also include observed speed data. For transit assignment, the independent data includes transit ridership and boarding counts. Other information, such as transfers, might come from a transit on-board survey, but this might not be an independent data source if the model was estimated using this data.



Key Message: Highway Assignment – Base Year Checks

Details:

We can characterize the base year highway assignment checks by three types: VMT checks, volume checks, and speed checks. Yes, we know that VMT—vehicle miles traveled—is computed from volumes. We distinguish checks of aggregate checks of volumes weighted by link length from checks of individual link volumes, which may include combined volumes for multiple links.

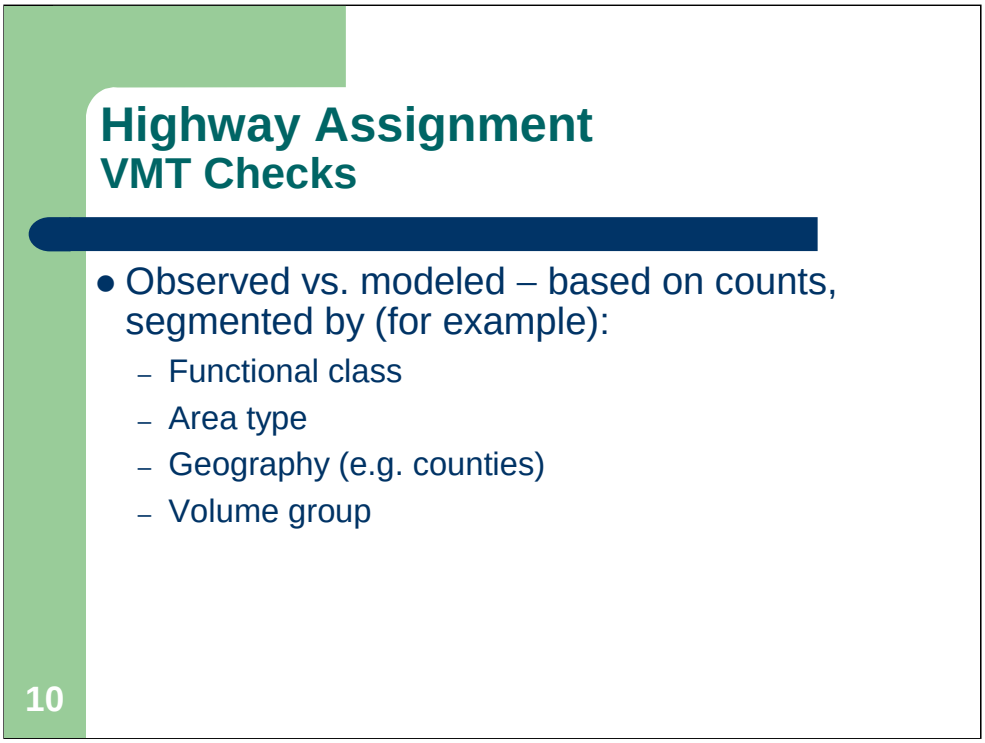


Key Message: Assignment and Route Choice

Details:

When we aggregately validate some model components, like mode choice, we are validating the direct results of the choice model (trips by mode). For assignment, which is route choice, we are not directly validating the routes chosen, but rather the volumes on individual links, which are components of potentially many routes. Even with transit assignment, we look at route level boardings, summed for all travelers.

This is considered aggregate validation since we are looking at the total volumes.

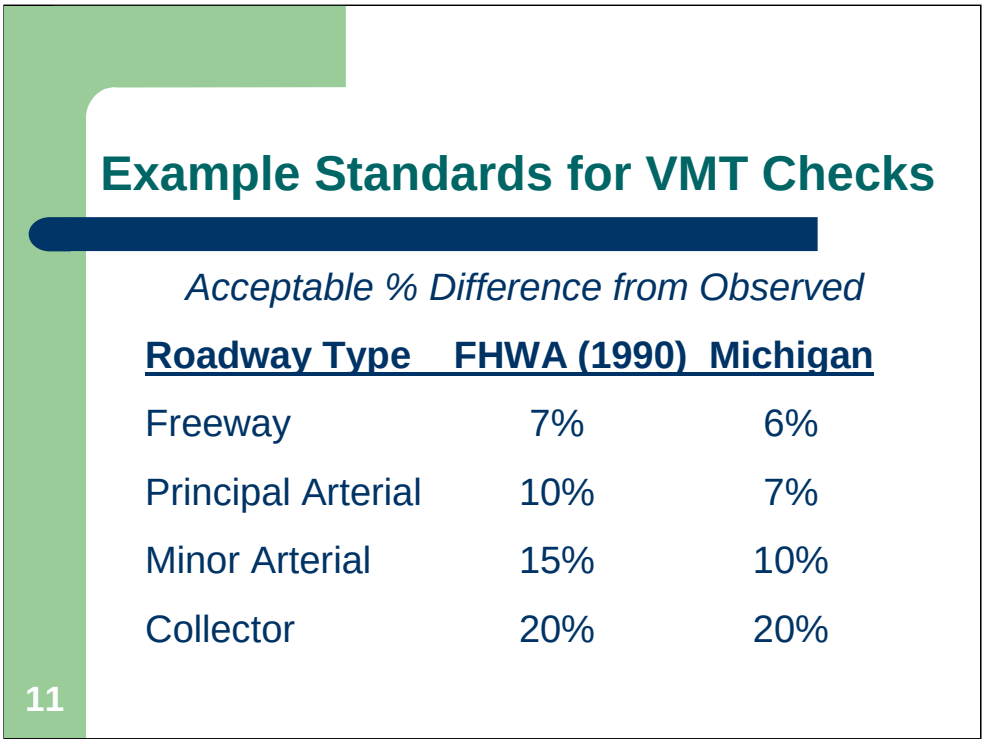


Key Message: VMT Checks for Highway Assignment

Details:

A basic comparison is the modeled vehicle miles traveled compared to the VMT computed from traffic counts. But matching the regional VMT does not by itself show that a model is validated, as there can be offsetting errors. So it is a good idea to segment the network links using a variety of segmentation schemes. These may include:

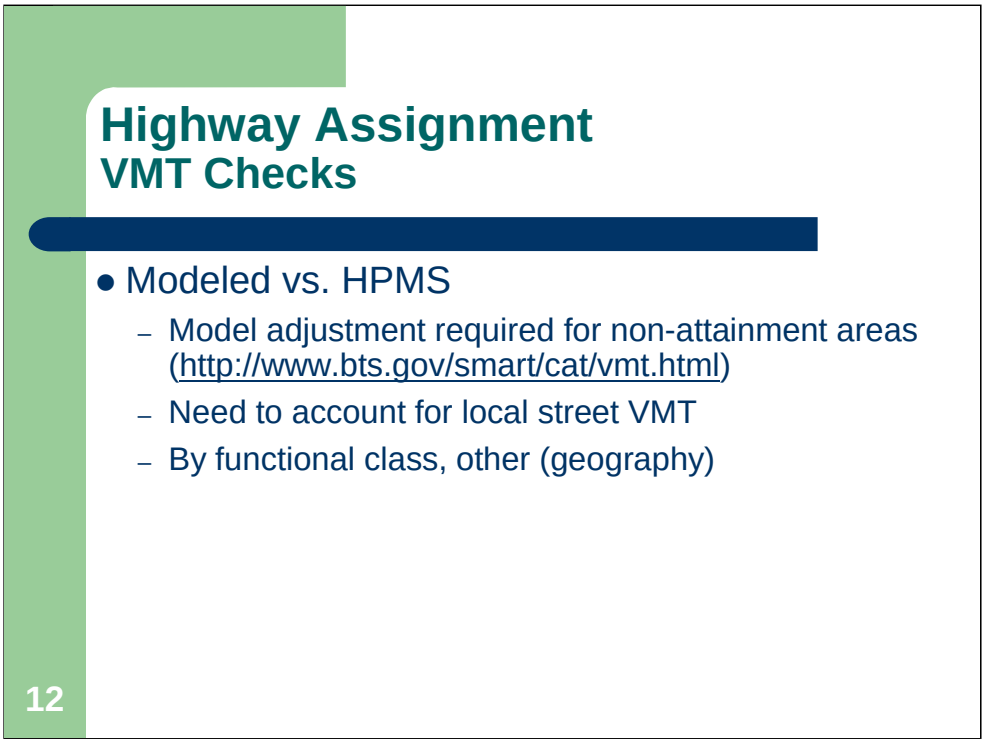
- Functional class
- Area type
- Geography (e.g. counties)
- Volume group



Key Message: Some Standards for VMT Checks

Details:

How close is close enough for the match between modeled and observed VMT? Here are some example standards that have been used for facility type. There are not many similar published standards for other types of link categories although some general conclusions can still be drawn from these types of comparisons. For example, VMT percentage differences should be greater for lower volume groups. Another example: If VMT is far off in some geographic areas (say, a particular county, or the CBD), it might help identify some issues with the model to be corrected.

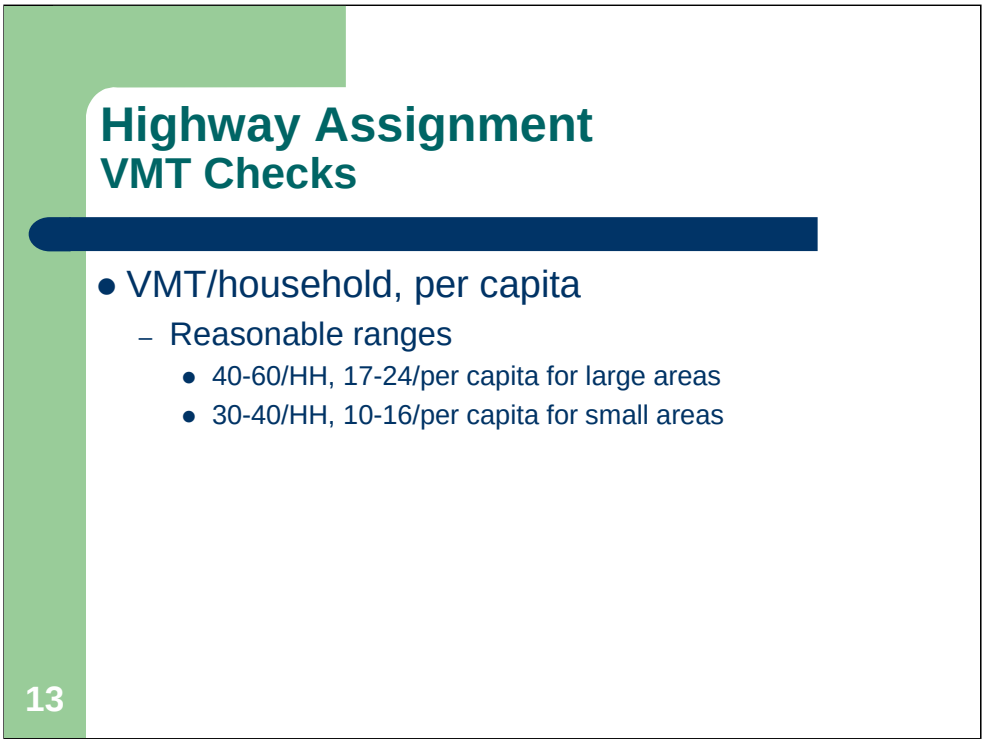


Key Message: VMT Checks – Modeled vs. HPMS

Details:

The Highway Performance Monitoring System (HPMS) is available in all states and provides estimates of VMT by functional class, based on a sample of traffic counts. In non-attainment areas, conformity regulations require that model results are adjusted to match the VMT from the HPMS. So if there are large differences between the modeled and HPMS VMT, the adjustment could be large, and this may indicate model issues.

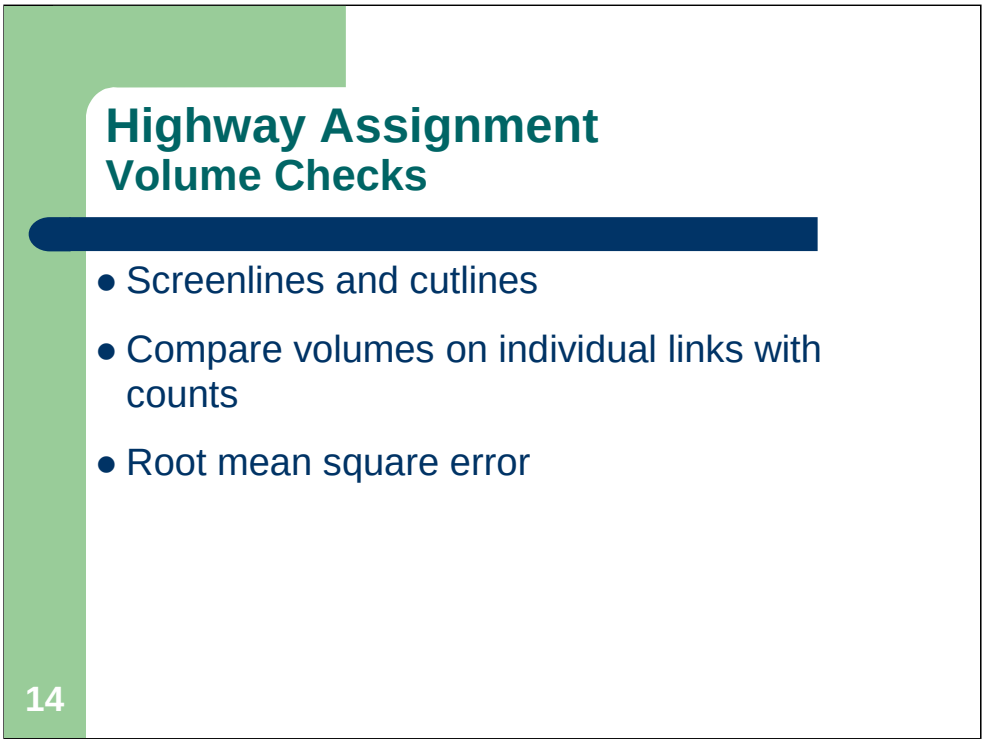
It is important to recognize, though, that HPMS provides VMT estimates for all roadways, not just the modeled network. So some way of accounting for local streets that are not in the model network must be used.



Key Message: VMT Checks – VMT per Household and per capita

Details:

Another VMT check is the total regional VMT per household and per capita. These "reasonable ranges" should be used with caution. In some areas, there is a lot of VMT generated by external or commercial vehicle travel while in others, especially smaller areas, a significant percentage of travel by the region's residents occurs outside the area. Being familiar with your own region is important for this type of check. If you know that commute distances in your region are longer than average, for example, then these ranges might be too low.

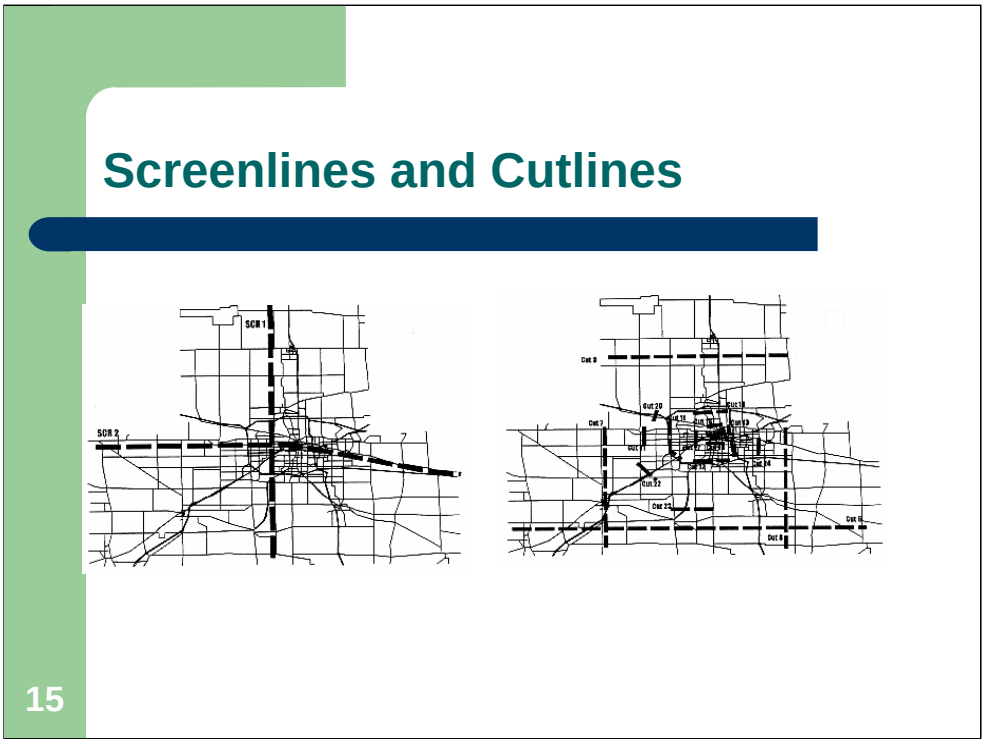


Key Message: Volume Checks - Types

Details:

Some volume checks include:

- Comparing modeled and observed volumes on screenlines and cutlines
- Comparing volumes on individual links with counts
- Computing the percentage root mean square error for groups of links



Key Message: Volume Checks – Screen and Cutlines

Details:

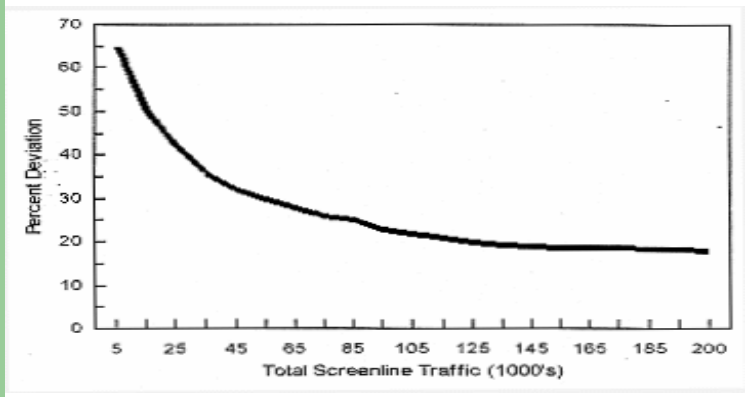
Screenlines and cutlines are lines drawn across the network and the modeled volumes on links crossing them are compared to the traffic counts on the links. Screenlines are lines that cross the boundary of the modeled region at both ends, cutting the region into two parts, as in the map on the left. Cutlines do not extend to the regional boundary at one or both ends, and trips can "go around" them. It appears that the four longest lines on the map on the right are screenlines, and the others are cutlines. It makes sense to have several screenlines and cutlines in all parts of the region.

Screenlines are probably more useful if drawn well because they can indicate issues with the trip tables as well as the network and assignment process. If a screenline is drawn well, it may be rare for a trip to cross it twice, meaning that the volumes crossing the screenline mainly are those with one trip end in the zones on one side and one on the other side. If the total modeled screenline volume is far different from the count, the trip table is inconsistent with the observed volumes.

However, sometimes it is necessary to use a cutline, either because of the network and regional geography, or because there are insufficient traffic counts to create a screenline.

Example Standards for Screenline Checks

Remember this?

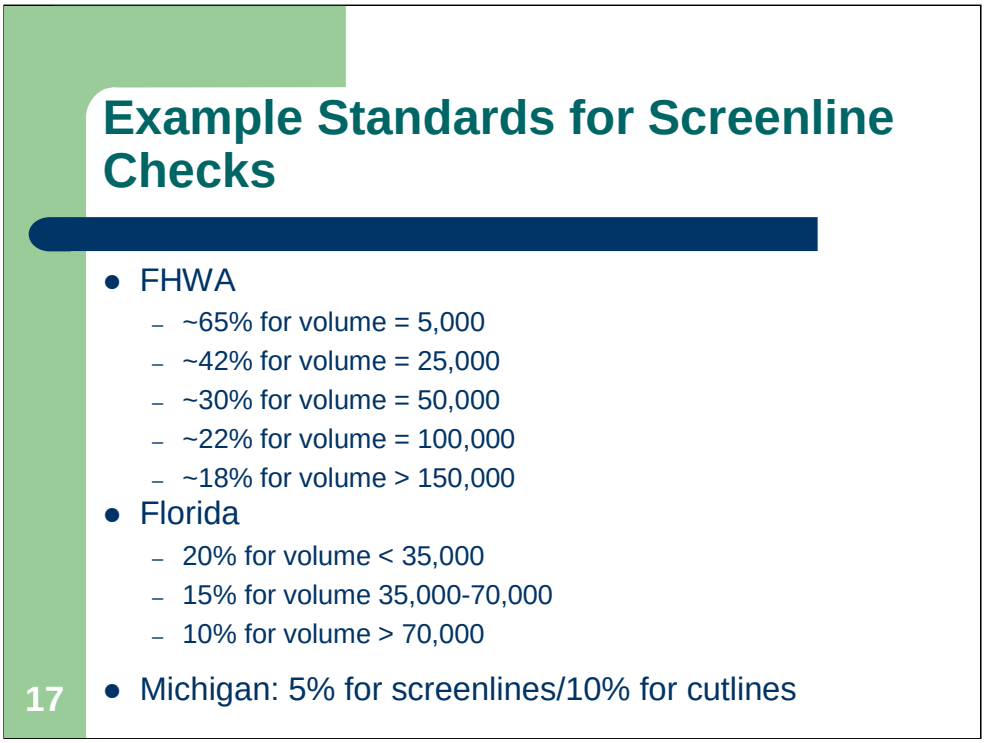


16

Key Message: Screenline Checks Standards

Details:

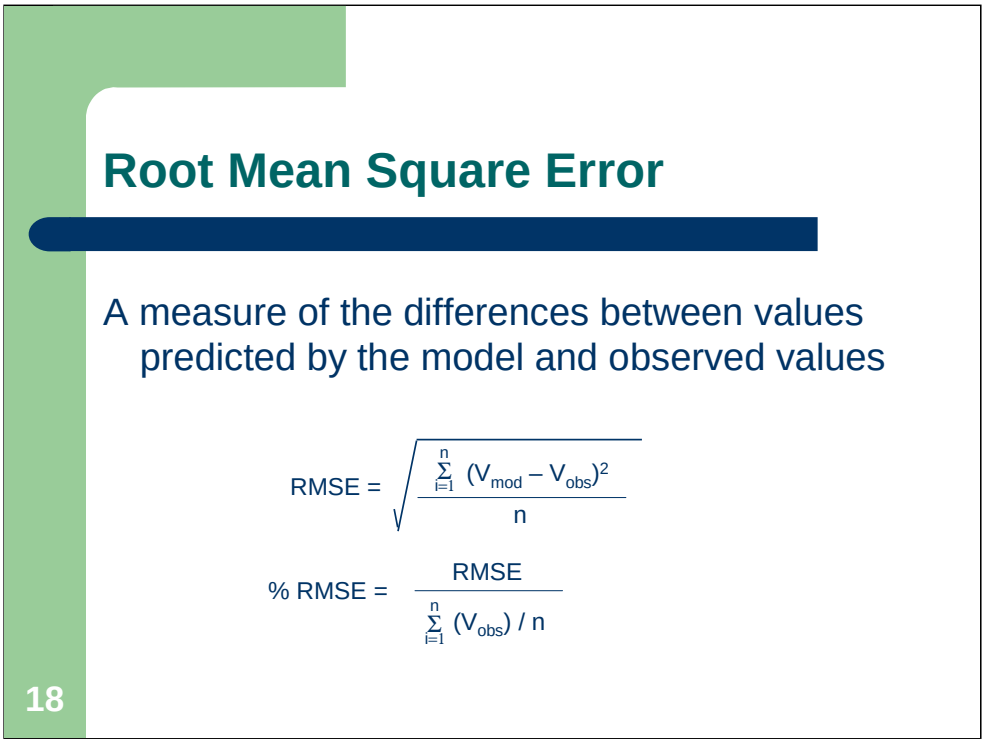
Remember this graph? If you do, then you are old like Tom; otherwise you are young like Yasasvi. This is from the 1990 FHWA report "*Calibration and Adjustment of System Planning Models*" and shows the acceptable percentage level of error for screenlines as a function of total volume across the screenline. While some planners find these "acceptable" percentages large—the acceptable error is never less than about 17% and for low volume screenlines is 50% or higher—the graph shows some important concepts. Lower volumes screenlines will generally have higher percentage errors, not only because the basis for the error computation is lower, but also because the percentage error associated with the traffic counts themselves will be higher for lower volumes.



Key Message: Screenline Checks Standards

Details:

These are some examples of targets for percentage errors for total screenline modeled volumes compared to counts. The 1990 FHWA standards are looser than most others.

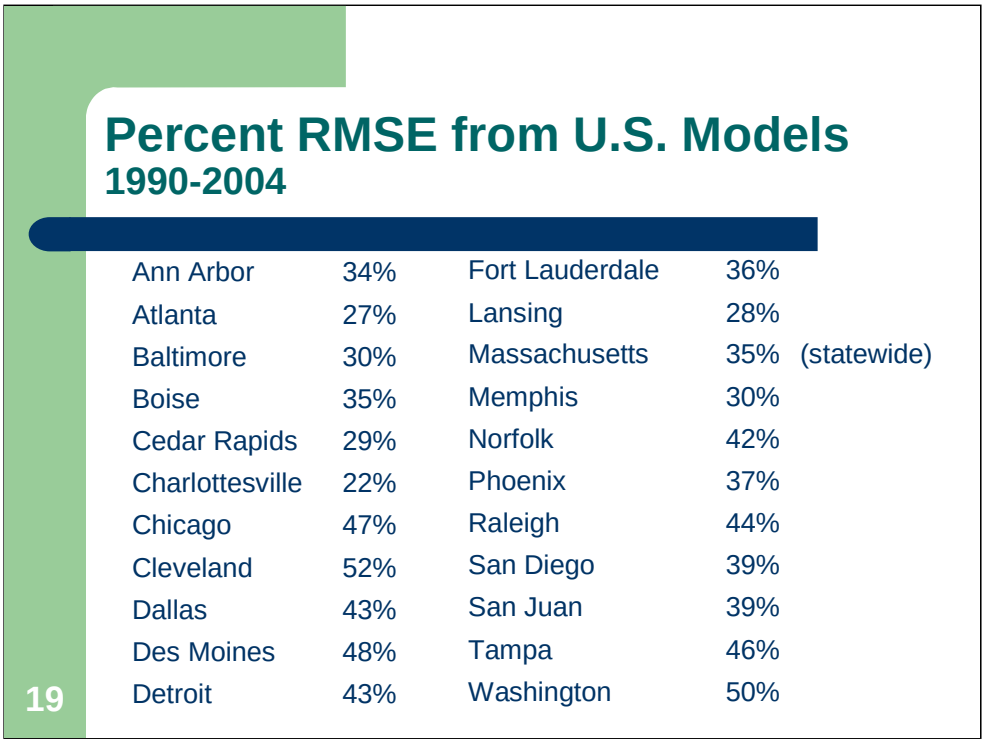


Key Message: Root Mean Square Error

Details:

Root mean square error is a common method for estimating the closeness of a match between a group of modeled data and the observed data to which they correspond. It is well suited to checking the accuracy of modeled link volumes compared to traffic counts. Offsetting errors do not present a false sense of accuracy using this measure.

For traffic assignment checks, it is informative to examine the percentage root mean square error, representing the average percentage error compared to the mean link volume. This is represented by the bottom formula. (Sometimes the denominator in the computation of average volume (the denominator of the overall formula) is shown as n-1, where n represents the number of counts, but in practice this makes little difference.)

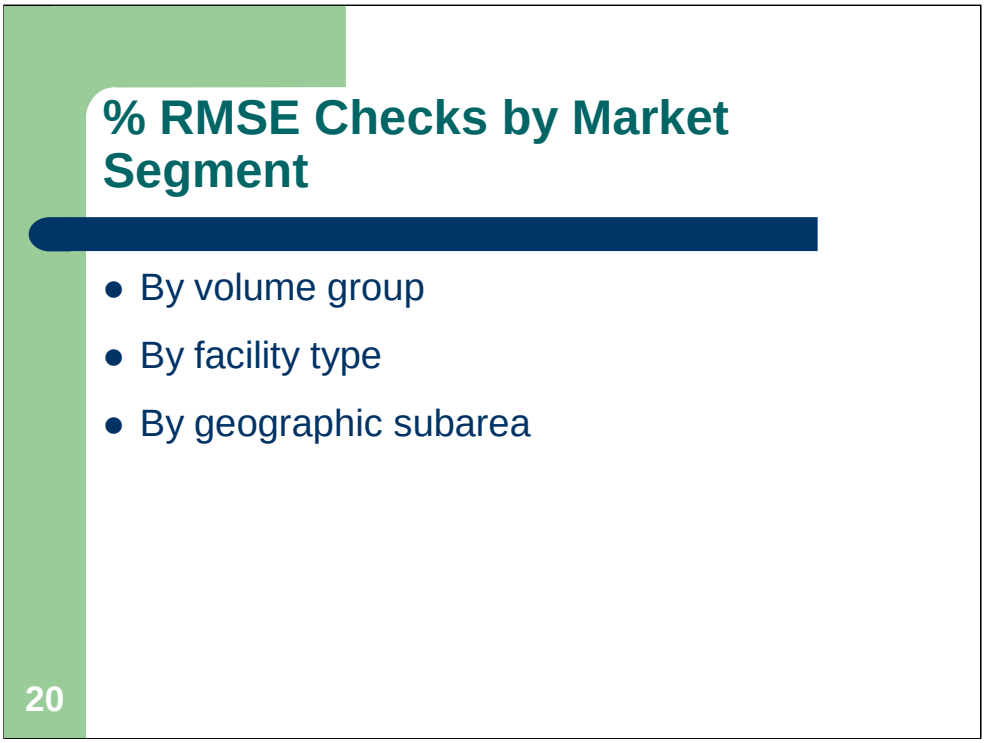


Key Message: %RMSE from Various US Models

Details:

It is customary first to check the regional percent RMSE. This chart shows the regional % RMSE for 22 regional and statewide models in the U.S. from 1990 through the mid-1990s (these figures may not reflect the current models in these urban areas). Typically, these values range from about 25% to 50%, with smaller urban areas usually having lower % errors.

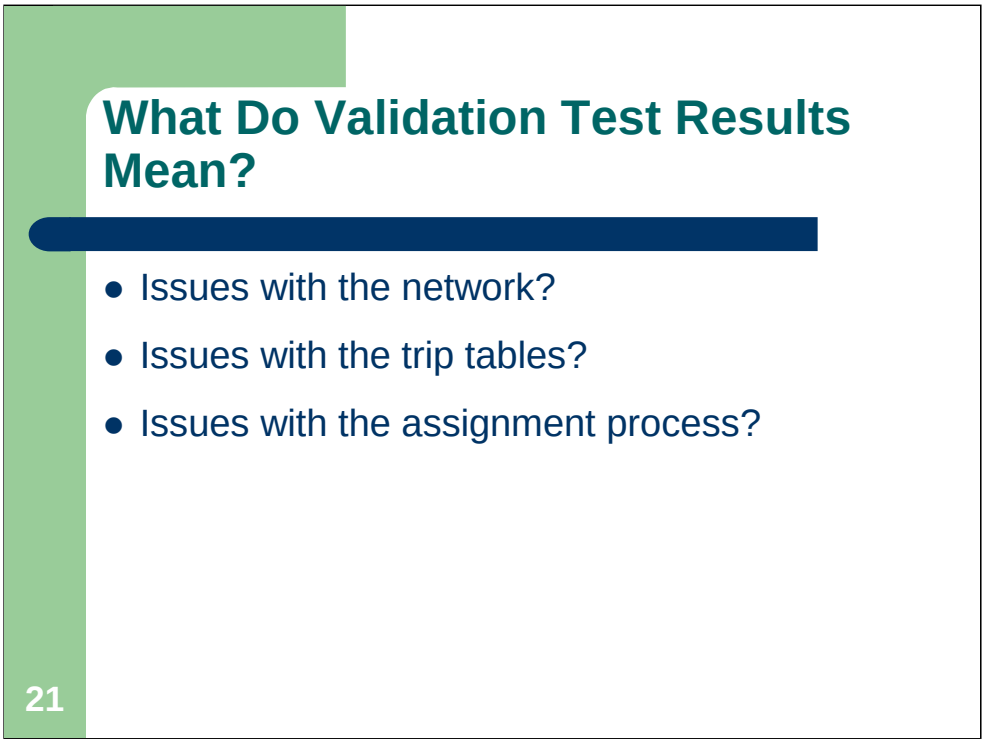
Some planners have noted that errors of this magnitude seem to be on the high side. However, it must be noted that this reflects an average of all types of roadways, including high and low volume facilities, and again the traffic counts themselves can have high percentage errors.



Key Message: %RMSE Checks

Details:

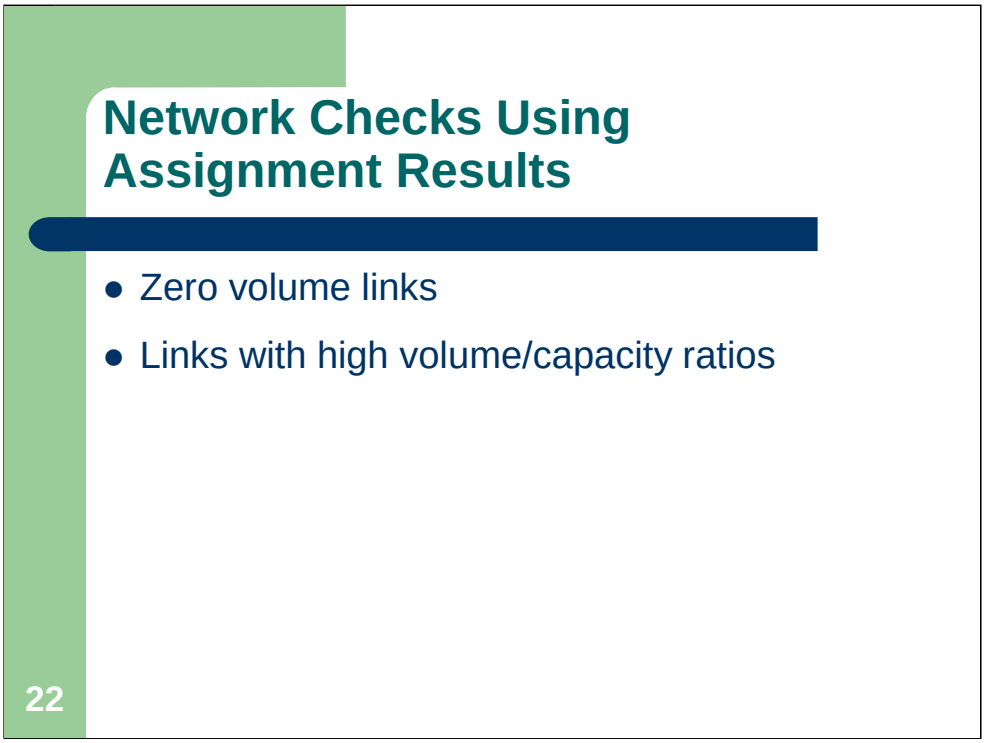
The %RMSE calculations need not be conducted for all the links together. In fact, it is better to stratify %RMSE calculations for links based on volume group (high volume links versus low-volume links), facility type (interstate, arterials etc), or by geographic area trip (urban, suburban, rural etc). Such computations will point to systematic under- or over-prediction for a set of links, and can be very helpful in validating the model.



Key Message: Meaning of Validation Test Results

Details:

So what does it mean when the validation tests show significant differences between modeled and observed volumes? This could be an indication of network coding problems, including incorrectly coded speeds, capacities, or other link characteristics, or poorly coded centroid connectors, or connectivity problems. Or there could be problems with the trip tables, indicating issues with trip generation, distribution, or mode choice. Or, the problem could be in the assignment process itself. For example, if the VMT is too high for one facility type and too low for another, perhaps different volume-delay functions for the different facility types are needed.

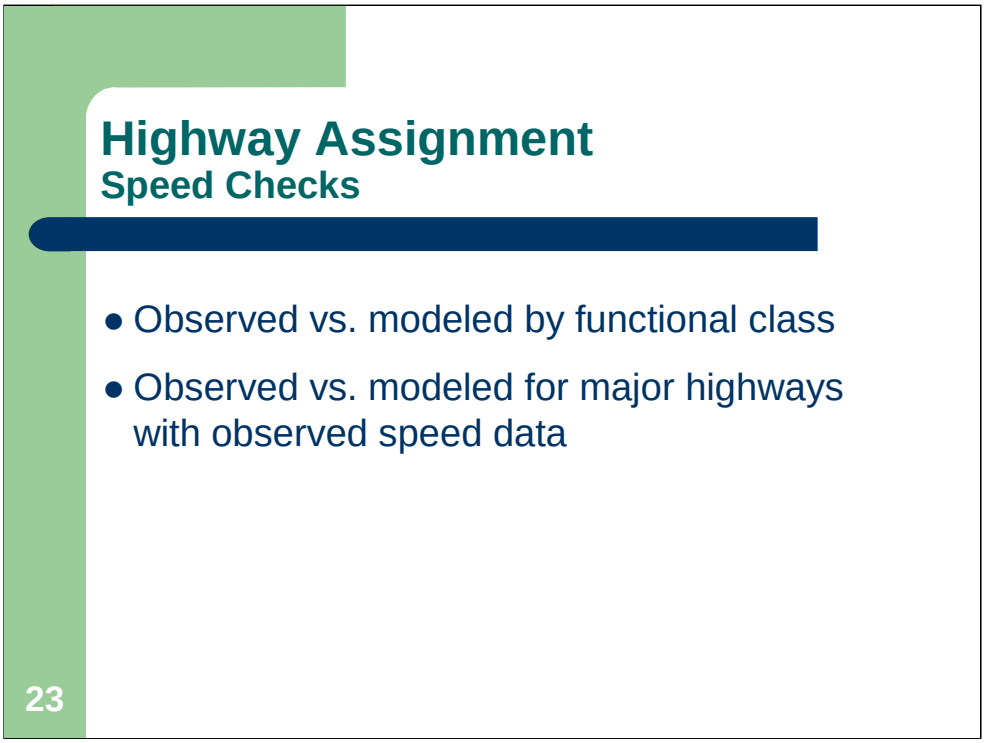


Key Message: Network Checks on Assignment Results

Details:

Some highway network checks cannot be made until a traffic assignment is done. It makes sense to check every link that has zero assigned volume. Unless these are “stub links” (dead ends), it makes sense for every link to have assigned volume. If it does not, it could indicate a problem with the link coding (for example, the speed is too low, or the length too great) or with the centroid connectors. Or, it could indicate that the link should not be in the network, given the zone geography and the level of detail.

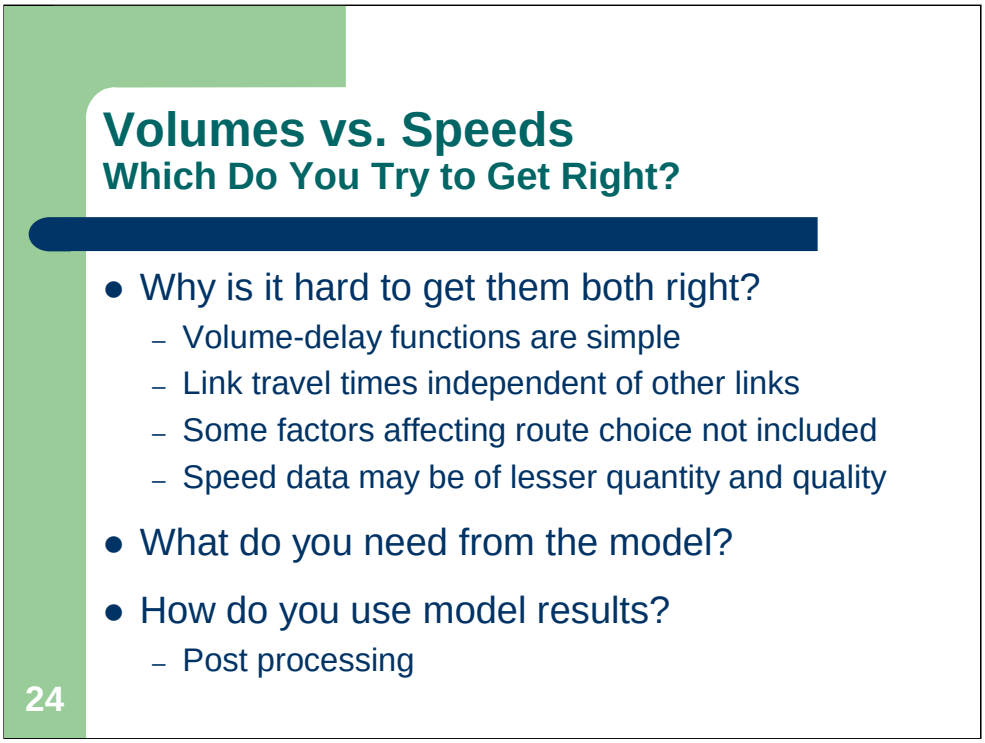
A very high volume on a link compared to capacity may also indicate a problem. Since volume-delay functions increase travel time rapidly at high v/c ratios, the assignment of so many trips to a link could indicate a link coding problem, either on the link, elsewhere on a path that uses the link, or on a competing path.



Key Message: Highway Assignment – Speed Checks

Details:

Two types of speed checks are usually performed for highway assignment results: observed versus modeled speeds for links grouped by functional class, and observed versus modeled speeds for major highways with observed speed data.

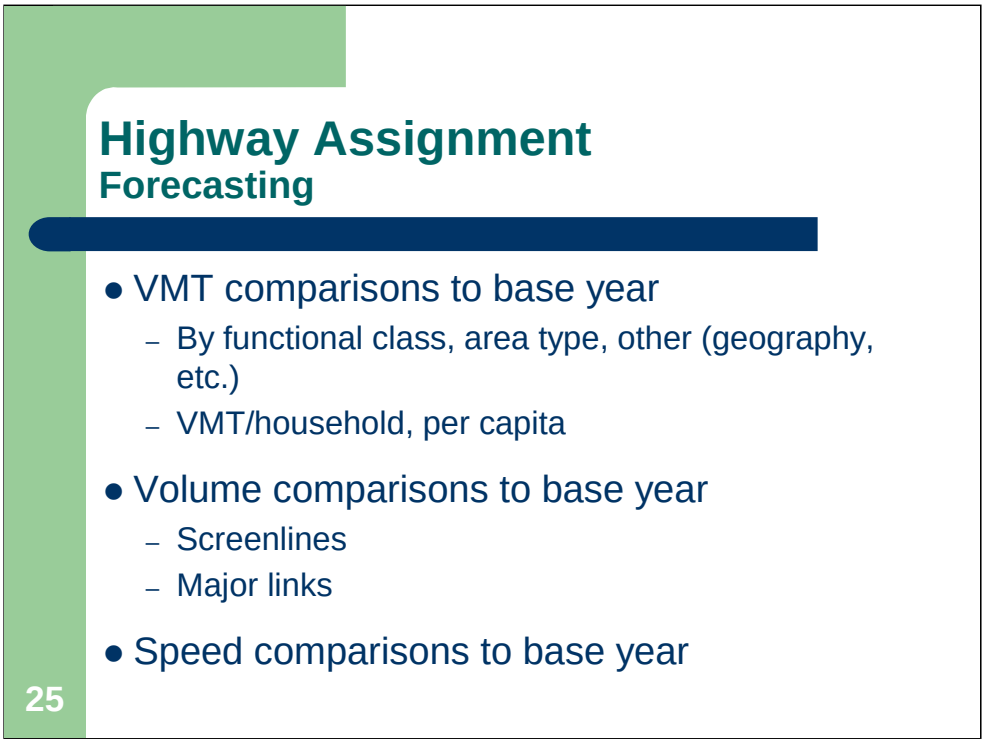


Key Message: Volumes vs. Speeds Validation

Details:

Generally speaking, we have more volume data than speed data. Of course, speed data is evolving with the advent of GPS technologies. Even with good speed data it is hard to get both volumes and speeds right. This is because, the volume-delay functions are fairly simple. Also, the link travel times are independent of each other as represented by the BPR function. Some factors such as reliability of travel times are not included in the route choice.

How important the speed data needs to be depends on what you need from the model, and how one uses the model results. Some modelers post-process the validated volumes and get the speed outputs. For air quality analysis, modelers will need more accurate speed data from the model. It must be kept in mind that the speeds obtained from a travel demand model have several limitations because the items mentioned above.



Key Message: Forecasting – Highway Assignment

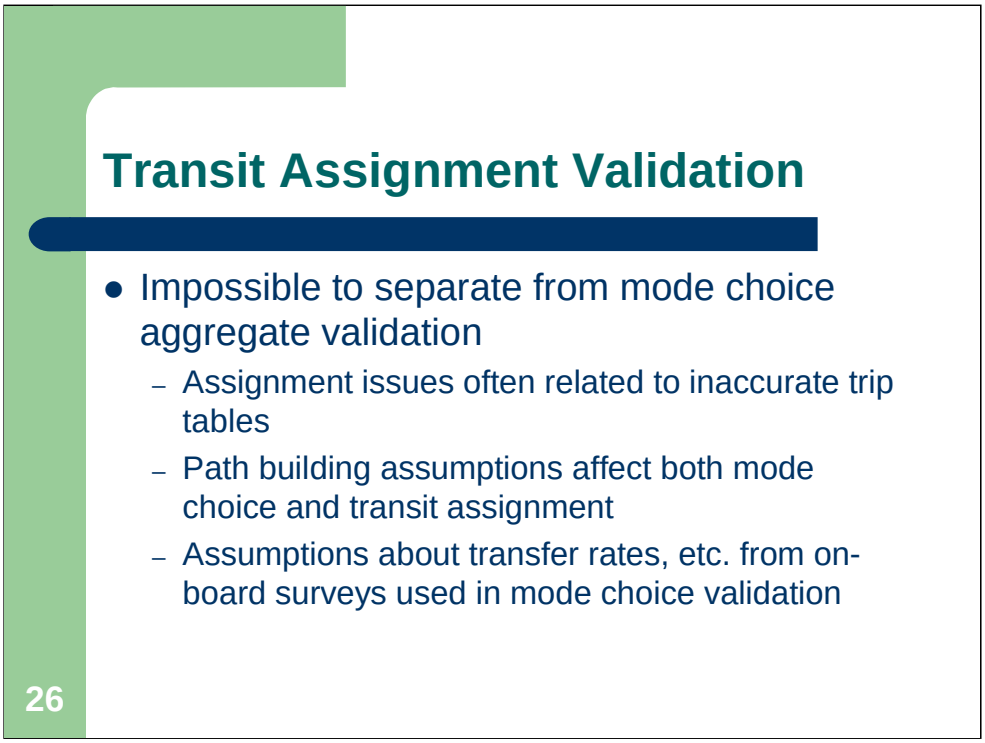
Details

There are no observed data for forecast years. So, modelers should compare the future year numbers with the base year numbers.

For example, the modelers should compare the VMT by functional class to understand where the biggest and smallest growth rates are, and to evaluate if these patterns make sense. Similarly, VMT per household numbers and VMT per capita numbers must be compared for base and future years and evaluated for reasonableness.

Similarly, volume comparisons can be made by screenlines and for major links to evaluate growth patterns.

Finally, speed comparisons can also be made across functional classes and area types to evaluate the model.

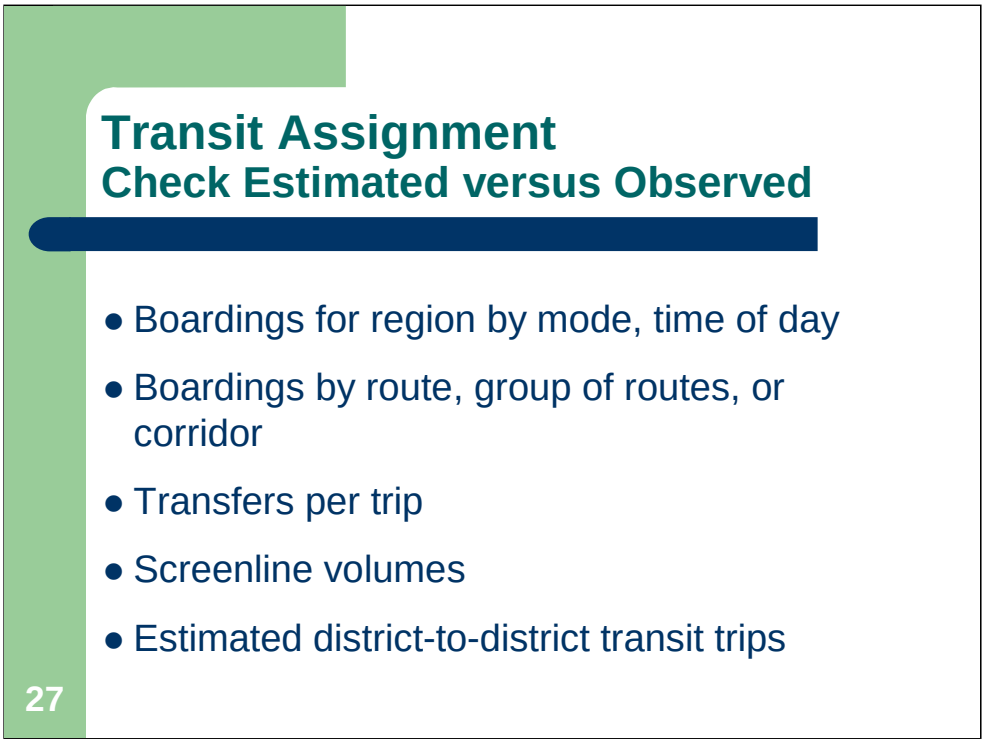


Key Message: Transit Assignment Validation

Details

It is impossible to separate transit assignment validation from aggregate validation of mode choice. This is because the transit assignment issues are usually a result of inaccurate trip tables and mode choice models. Also, the path building assumptions made in the software affect both mode choice (by way of LOS skims) and transit assignment. Also, the validation measures such as transfer rates etc. come from the onboard surveys which are also used to estimate the mode choice models.

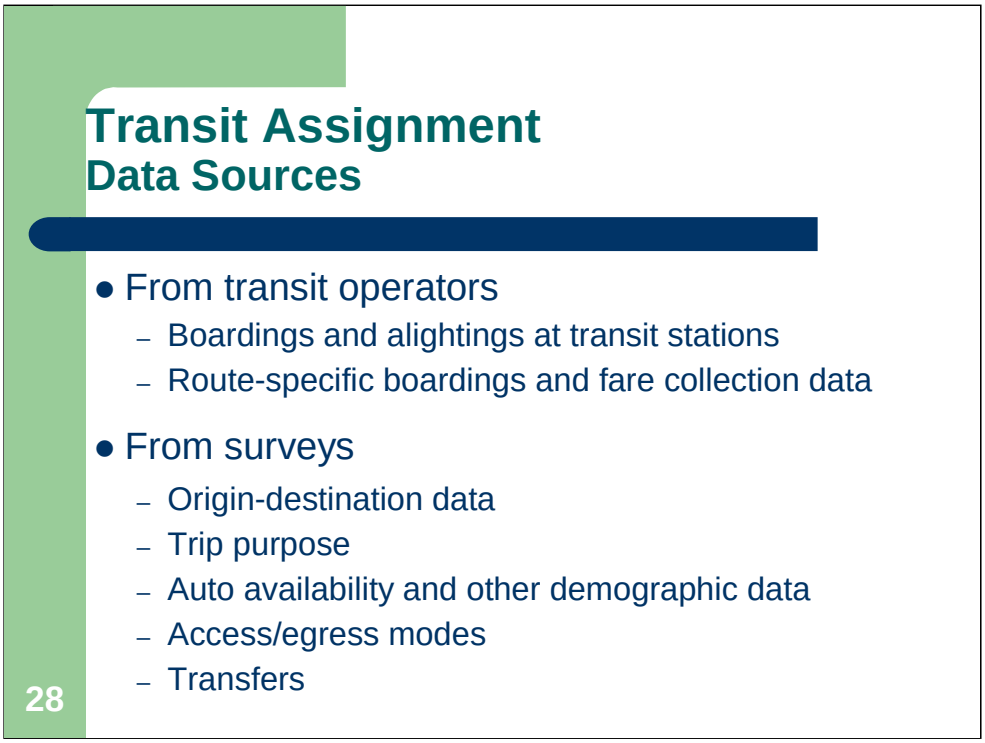
So, in essence one must try to look at the transit assignment in conjunction with mode choice.



Key Message: Transit Assignment Validation - Checks

Details

Several checks are recommended toward the validation of transit assignment. At a region-wide level, looking at overall boardings by transit mode (rail, bus etc) by time of day is a good start. At a more disaggregate level, boardings by route, group of routes or even a pre-identified corridor. Making sure that the transfers per trip (transfer rate) is reasonable is extremely important. As with highway assignment, screenlines can also be used to compare observed and modeled volumes. Finally, district-to-district transit trips from model can be compared with those from the onboard survey. This will give a sense of the accuracy of the directionality and magnitude of linked transit trips coming out of the mode choice model.



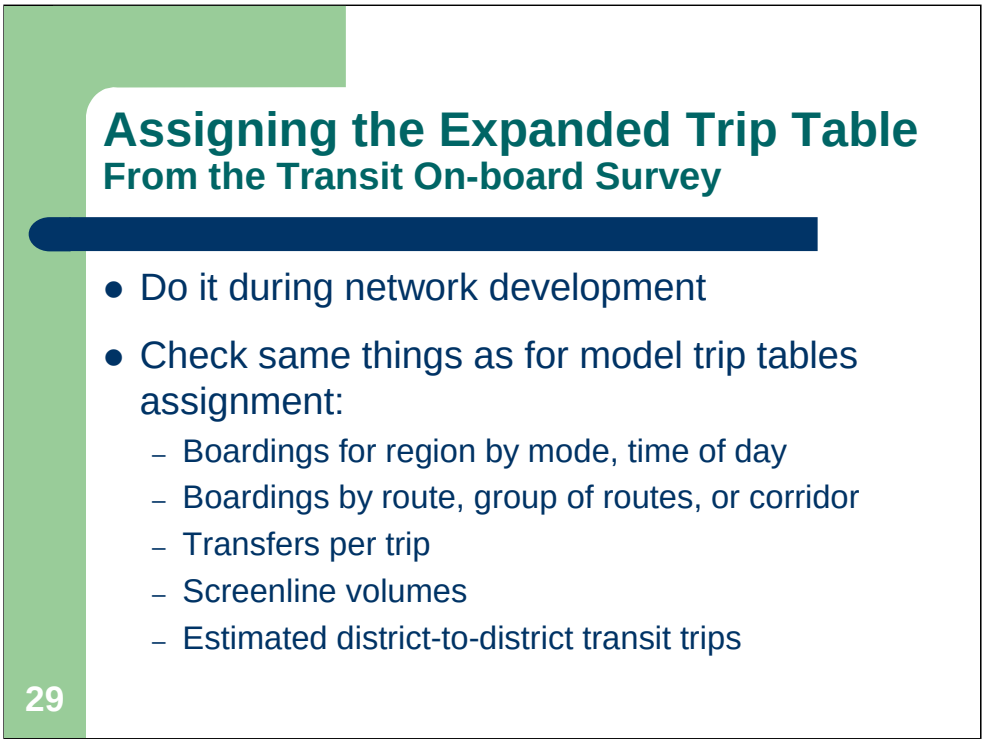
Key Message: Transit Assignment Validation – Data Sources

Details

Several sources of data are available for transit validation.

Boarding and alighting data at a stop/station-level are usually available from transit providers. Similarly, route-specific boarding counts are also extremely useful in validating model results.

Data can also be obtained from transit onboard surveys. These data include origin-destination patterns of transit trips, their trip purpose, the captivity of transit users as indicated by the auto availability and income information, access and egress information, and transfer patterns.

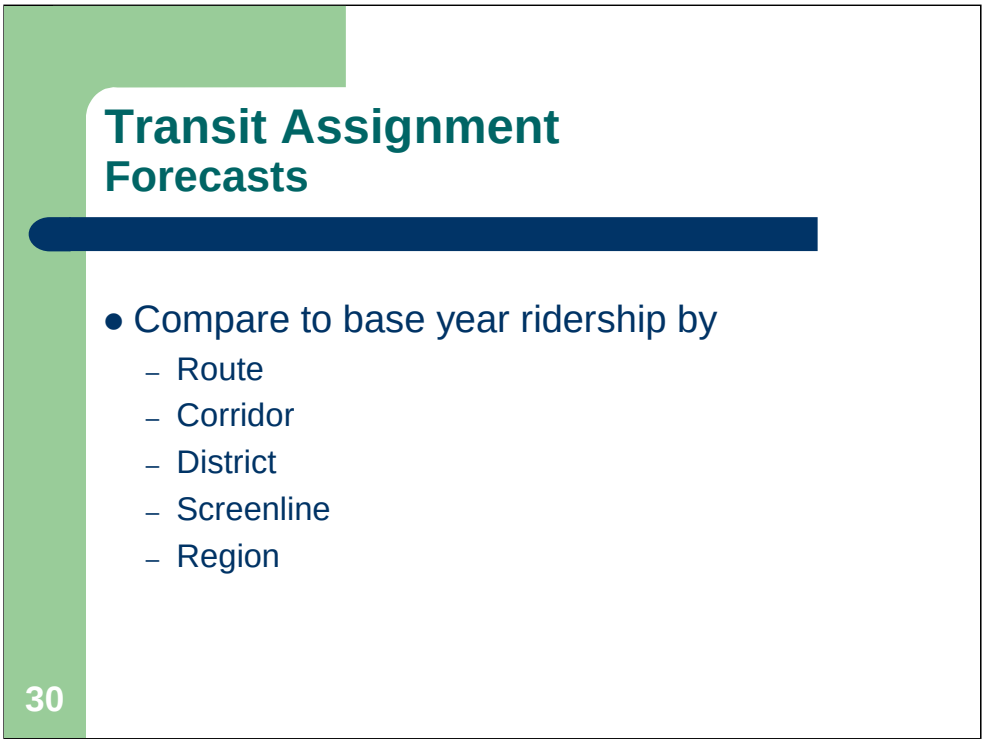


Key Message: Assignment of Expanded Trip Table from Onboard Surveys

Details

It is advisable to assign the expanded trip table **directly** obtained from the onboard survey to the transit network. This must ideally be done during the transit network development phase. This will enable the modeler to find any problems with the network itself.

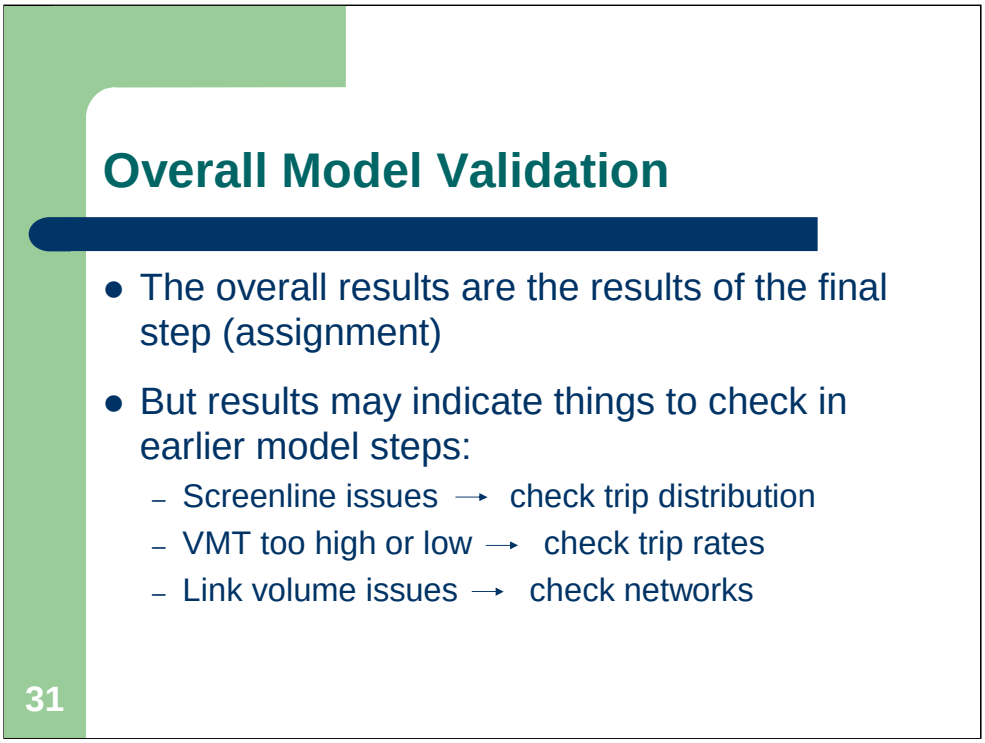
Once the onboard trip table is assigned to the network, the assignment results can be checked in very much the same manner as the model assignment results are checked using boardings by route, group of routes, corridors, and transfers per trip.



Key Message: Transit Assignment - Forecasts

Details

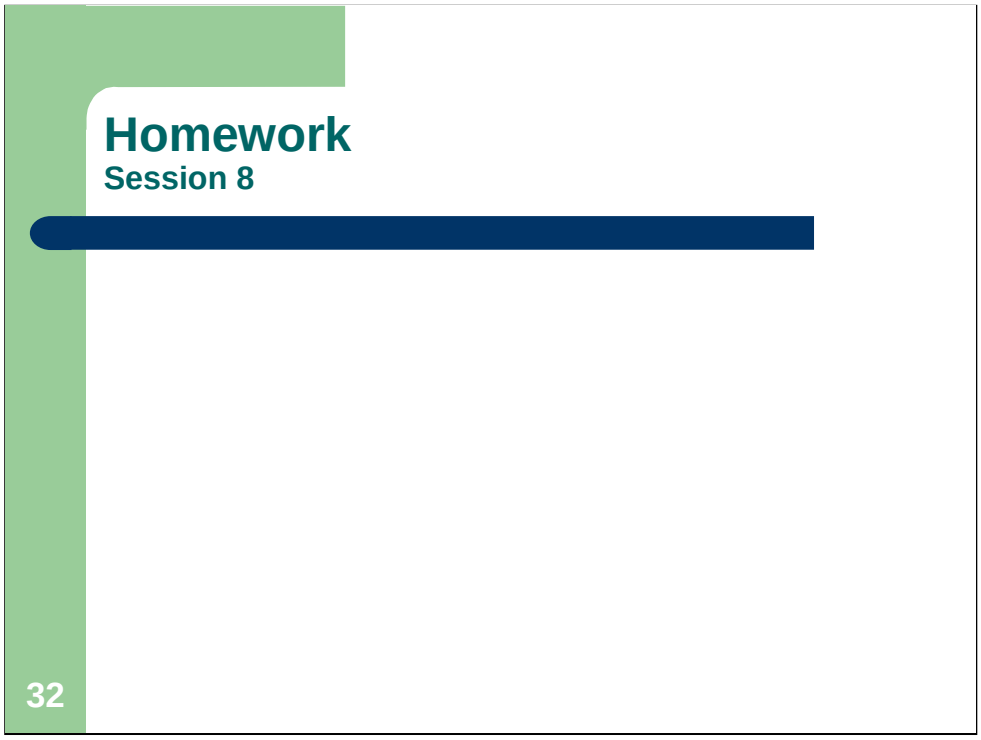
Comparing base year and forecast year ridership by route, corridor, district, screenline, and the entire region for various time periods can yield useful insights into checking and validating the model. If the growth is too high or too low, then various model components may need to be revisited and checked.



Key Message: Overall Model Validation

Details

So far, we have validated each model component individually. The overall results are the results of the assignment step, which is usually the last step. But depending on the assignment validation results, the modeler may need to check prior model components. For example, if there are major issues with screenline volumes, a check of the trip distribution model is in order. If the VMT is too high or low, the trip rates from the trip generation component will need to be checked. Also, if there are link volume issues, the network coding will need to be examined.



Key Message: Homework

Details:

The homework for Session 8 can be downloaded from the course website. We would strongly recommend that the participants work through the homework problems to get more value out of this session.